In-Space Propulsion Engine Architecture based on Sublimation of Planetary Resources: From Exploration Robots to NEO Mitigation

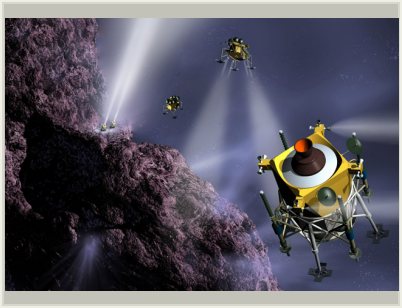
Completed Technology Project (2011 - 2012)

Project Introduction

The sources of power used for deep space probe missions are usually derived from either solar panels for electrical energy, radioisotope thermal generators for thermal energy, or fuel cells and chemical reactions for chemical energy and propulsion. This NIAC study will investigate the ability to access local resources on planetary bodies and to transform them into forms of power that will expand the capabilities of future robotic and human missions, which will face new challenges as we continue to explore planetary bodies beyond the Moon. The surface materials found on asteroids, comets and terrestrial moons and planets consist mainly of minerals composed of metal oxides, but they also contain ices of substances such as water and carbon dioxide all of which can be vaporized thermally into gases at moderate temperatures due to low atmospheric pressure conditions. Phase I of this NIAC study will focus on verifying the assumptions currently made about the properties of solid volatile ices found throughout the solar system, and demonstrating through experiments how much gaseous material can be produced from them to provide useful mechanical power for such activities as lifting objects using actuators and for providing cold gas propulsion. The work will also investigate new engineering concepts for using the gasification of ice and mineral rocks found inside asteroids and comets in order to divert their path away from a potential collision course with Earth.

Anticipated Benefits

We investigate the concept of sublimating the ices and minerals on planetary bodies to form gases where favorable environmental conditions prevail on many bodies in the Solar System. The applications offered by this resource sublimation concept range from powering surface systems during planetary missions to using in-space propulsion to deflect near-Earth objects (NEOs) threatening our planet.



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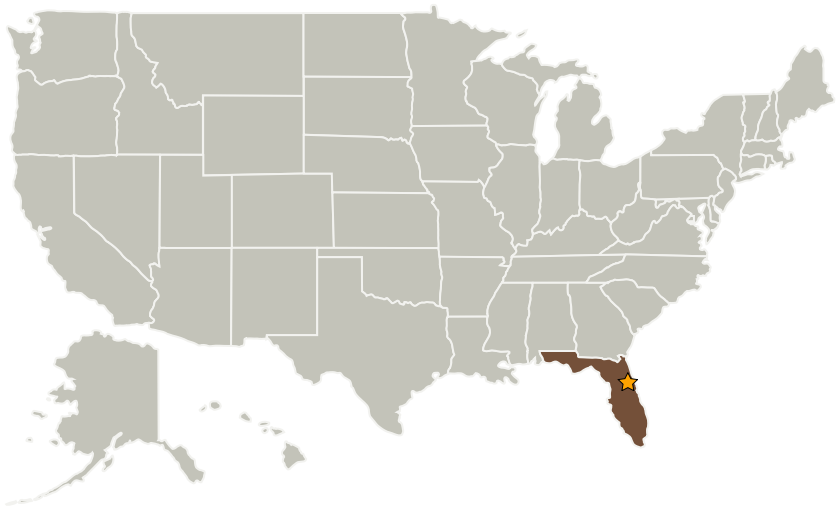
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
University of Houston-Clear Lake	Supporting Organization	Academia	Houston, Texas

Primary U.S. Work Locations
Florida

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

NASA Innovative Advanced Concepts

Project Management

Program Director:

Jason E Derleth

Program Manager:

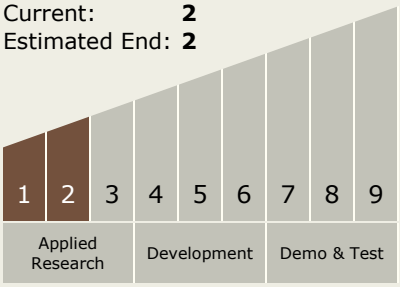
Eric A Eberly

Principal Investigator:

Laurent Sibille

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



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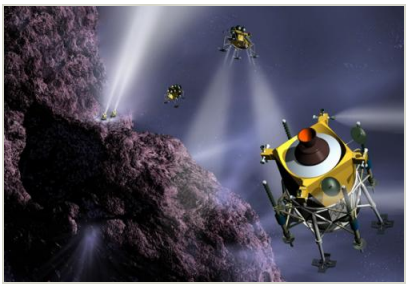
Images



Project Image In-Space Propulsion Engine Architecture based on Sublimation of Planetary Resources: From Exploration Robots to NEO Mitigation
In-Space Propulsion Engine Architecture based on Sublimation of Planetary Resources: From Exploration Robots to NEO Mitigation Project
(https://techport.nasa.gov/image/102212)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

The Moon, Mars, Others Inside the Solar System